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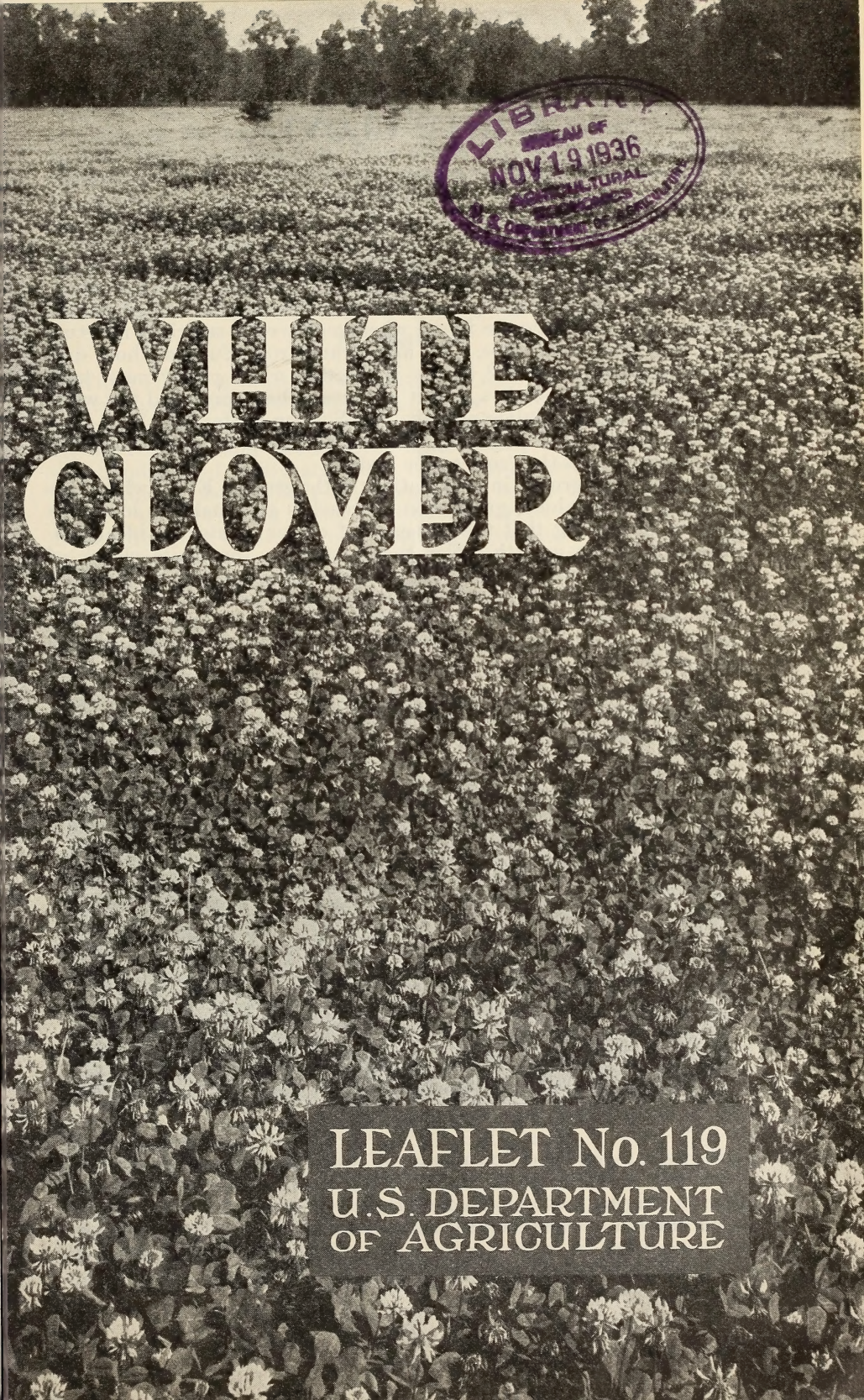
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WHITE CLOVER

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U.S. DEPARTMENT OF AGRICULTURE

WHITE CLOVER

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White clover (*Trifolium repens* L.) is a common but often unappreciated inhabitant of pastures, lawns, roadsides, and thin woodlands. It is found widely scattered throughout the United States. Occasional plants may be found wherever there is sufficient moisture to enable them to survive. An immigrant from Europe whose date of entry into the United States is obscure, white clover must have arrived with early settlers, and it appears to have preceded the white man into the Ohio Valley and Middle Western States.

White clover is a profusely seeding perennial legume, spreading by creeping stems that root at the nodes.

It normally grows in association with grass. Even when this clover is seeded alone, grass soon encroaches and makes a luxuriant growth, indicating that the presence of clover creates an ideal condition for grass growth. For the most part, the white clover of permanent pastures has not been intentionally seeded by man but may have been disseminated by animals or as an impurity in other field seed. When grown in mixtures with grass, it increases the carrying capacity of the pastures and provides a nutritious feed relished by livestock (fig. 1).

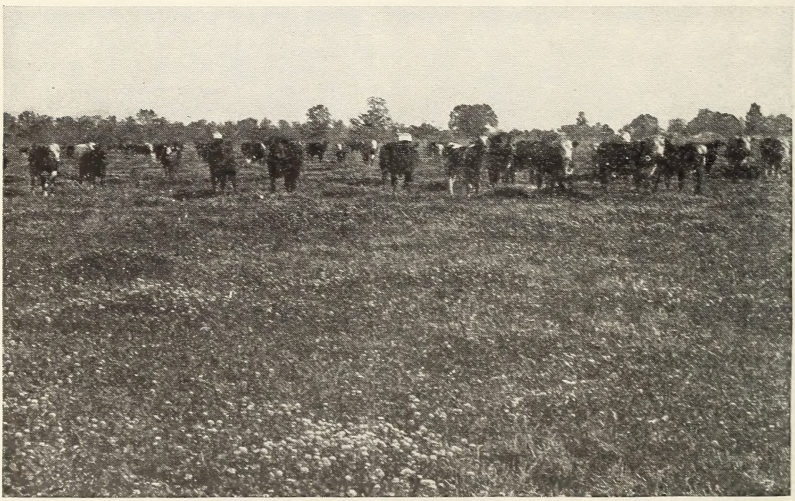

FIGURE 1.—Livestock pastured on white clover.

Between 2 and 3 million pounds of white clover seed are annually consumed in the United States. About half of this amount is of foreign origin; most of the imported seed comes from Poland and small amounts come occasionally from other northern European

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countries and from the British Isles. No definite information is available on the uses of white clover seed in this country, but it is believed that approximately 95 to 98 percent is used in lawn-seed mixtures. While the amount of white clover seed produced in the United States fluctuates widely from year to year, the three principal seed-producing regions and their relative importance in the United States are (1) Louisiana, (2) Idaho, Oregon, and Washington, and (3) the northern Corn Belt States, principally Wisconsin. Formerly, most of the seed was produced in the northern Corn Belt States.

Pollination

White clover is practically self-sterile; that is, the florets have to be cross-pollinated before seed will form. This means that pollen must be transferred from plant to plant rather than from one floret to another on the same head or the same plant. The florets produce an abundance of easily accessible nectar and, therefore, are visited by all kinds of bees, which in their quest of nectar cross-pollinate the flowers, thus bringing about continuous variation in the progeny. Under different environmental conditions various types and forms of white clover have developed and survived, giving this plant a wide range of adaptation.

Culture

White clover, like all the other clovers, thrives best under cool, moist growing conditions, in soils abundantly supplied with lime, phosphate, and potash, but it is more tolerant of adverse conditions than any of the other important clovers. Clay and loam soils, provided they remain sufficiently moist to keep the plants alive, seem better suited to white clover than sandy soils, probably because of the droughty nature and lower mineral content of the sandy soils. White clover is not regular in its persistency of growth. It occurs abundantly in some years, but diminishes in others to such an extent that it almost disappears. The reason for this spasmodic behavior is not clear. Experiments have shown that the application of from 200 to 400 pounds per acre of phosphate fertilizers is beneficial to the growth of this plant, and while it will grow on acid soil its growth is never so thrifty as when available lime is present. Occasionally, clover leaves become spotted with irregular light-brown areas, even in the absence of disease-producing organisms, a condition which has been remedied by the application of 75 to 150 pounds of potash fertilizer per acre.

On most soil types, after stands are established, an application of phosphate at frequent intervals has been shown to be beneficial to the growth of white clover. The top dressing of white clover with limestone and potash has in many places given profitable returns. Repeated applications of fertilizers containing a high percentage of nitrogen have generally been unfavorable to the growth of white clover.

As white clover usually grows in association with grass, climatic conditions and cultural treatments affecting the grass may indirectly affect the clover. In England the management of pastures which are composed in part of white clover has a pronounced influence on

clover behavior, and there is reason to believe that management may be a factor of equal importance in this country. In England, pastures which are well supplied with mineral fertilizers and kept closely grazed or cut maintain continuous stands of white clover. Similar management of several pastures in New York has been successful in the maintenance of white clover, but whether this method has a wide adaptation in the United States remains to be proved.

Seedbed Preparation and Seeding

Except for seed production, white clover is usually planted with grass either in new seedings or on an established turf. When new seedings are made in the spring, white clover is mixed with the grass seed and the entire mixture sown at one time. Occasionally grass seedings are made in the fall, followed by the seeding of white clover early in the spring. Fall seeding of white clover is not recommended unless soil and climatic conditions are such as to induce early and rapid growth before cold weather arrives. Regardless of the time of seeding, the seedbed should be well compacted to facilitate the establishment of the young clover seedlings. This may be accomplished by rolling the soil, preferably with a corrugated roller. When the seedbed is being made, liberal applications of limestone, phosphate, and potash fertilizers should be applied. The seed may be broadcast and, if sown early in the spring, the covering of the seed may be left to the natural action of the alternate freezing and thawing of the soil. If it is seeded later in the season it may be advisable to stir the soil surface lightly to cover the seed. If white clover is to be seeded on turf it is advisable to have the grass short and kept in such a condition until the clover has become established.

Usually 2 to 5 pounds of seed per acre or 1 to 3 ounces per 1,000 square feet will produce an excellent stand, especially with seed germinating 95 percent including the hard seed. Inoculation of the seed is generally not necessary.

Diseases and Insects

White clover seldom becomes diseased. Occasionally, stem rot (*Sclerotinia trifoliorum* Ericks.) is responsible for a thinning of plants, although no reports have been received indicating that entire stands have been killed. Irregular brownish spots often occurring on white clover leaves are caused by several organisms. These diseases seldom kill the plant but when numerous reduce the quality of the forage.

During late spring and summer, leafhopper (*Emposaca fabae* Harr.) infestations cause a reddening and marginal browning of white clover leaves. Many young leaves are killed outright. The growth becomes stunted, and many plants are undoubtedly killed. With the advent of cool, moist weather the surviving plants recover. Ladino clover is particularly susceptible to leafhopper injury.

A grayish, mottled appearance of the leaves of white clover may be caused by the feeding of a minute black bug, the garden flea hopper (*Halticus citri* Ashm.). This bug sucks up the sap as food, is widely distributed, and occasionally is seriously injurious to all varieties of white clover.

Both the roots and leaves of the plant may be attacked by the clover-root curculio (*Sitona hispidulus* Fab.). The grubs gnaw the roots and the adults may riddle the leaves when the insect is abundant. This curculio is commonly present throughout the East Central and Atlantic States.

Both the clover leaf weevil (*Hypera punctata* Fab.) and the lesser clover leaf weevil (*H. nigrirostris* Fab.) frequently attack white clover, especially where this is grown in lawns. As both larvae and adults feed exclusively upon the foliage and young shoots, considerable damage may occur. Most of this is done in April and May, as the larvae usually succumb to the attacks of a fungus disease later in the season.

Varieties

Three recognized forms of white clover are now in use. These differ in characteristics and performance although there is great variation within each type. They are called common white Dutch, Ladino, and English wild white.

Common White Dutch

Common white Dutch clover is composed of a great number of forms, selections of which have been naturally and artificially made and maintained under specific environmental conditions. The selections in agricultural use do not differ greatly and are not distinguished by specific characteristics although some selections have leaves composed of four and five leaflets, while others have purple seed and rose-colored flowers. Studies have been made on the performance of white clover of widely different origin. Except in the more northern locations, where winter killing has been reported, plants produced from Louisiana seed have appeared to be slightly more persistent and productive than those from other sources. These plantings have been made alone and may not represent the true behavior of the form when planted with grass. In Louisiana white clover is grown as a companion crop with Bermuda grass and under such conditions the development of a long-lived perennial strain is favored. In some sections white clover is planted with a companion grain crop in rotation. Seed is harvested the second year, and then the clover is turned under for green manure. When many generations of seed are collected by such methods the development of biennial and short-lived perennial forms is likely to result. On the other hand, seed harvested from plants growing in old established pastures may represent long-lived persistent types. This has been shown to be true in England.

Ladino

Ladino clover originated in northern Italy and was introduced into the United States in 1912. It is the largest-growing form of white clover, as shown in figure 2. Under similar conditions it grows nearly twice as large as common white Dutch but does not differ in plant characteristics other than in size of all parts except seed.

While Ladino has been widely tried throughout the United States its use has been largely confined to the irrigated lands of the

Pacific Coast and Intermountain States. Nevertheless, it may become of importance in the humid Eastern States when soil conditions are made ideal for its growth and when the field is properly managed. Ladino seems to be less tolerant of poor soils and rough treatment than common white Dutch. In the Pacific coast and intermountain regions it is principally used as a grazing plant, either alone or in combination with grass. Seeding with grass is recom-

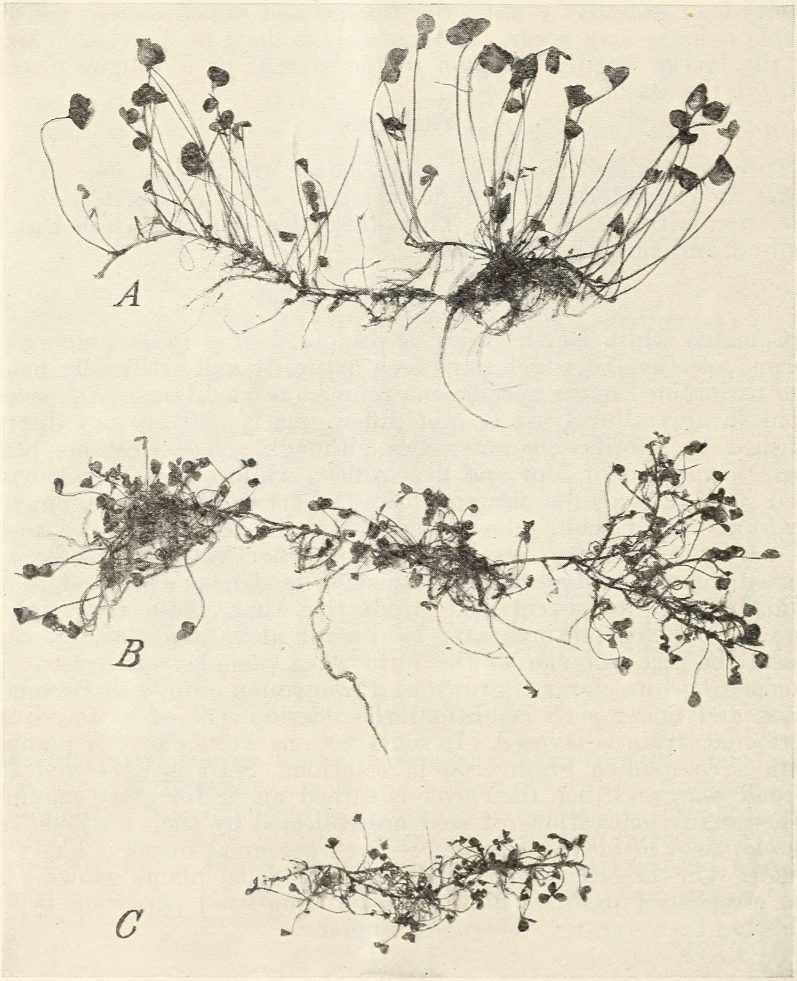

FIGURE 2.—Comparative size of Ladino (*A*), common white Dutch (*B*), and English wild white (*C*). Plant sizes reduced in photographing.

mended as a means of reducing the bloat hazard which is present when cattle and sheep graze on pure Ladino. In pasturing Ladino clover it is inadvisable to let it be grazed closely and the livestock should be removed when the pasture is to be irrigated to permit the plants to make additional growth, before being subjected to further grazing. In many places in the Pacific coast region, Ladino is made into hay. The yield of Ladino alone is low, but the hay

is very nutritious and palatable. Since the seed of Ladino commands a much higher price than common white Dutch the substitution of the latter for Ladino may occur in trade without detection as the seed of the two cannot be distinguished. The purchase of certified Ladino seed is therefore recommended.

English Wild White

For many years farmers in England have been harvesting white clover seed from old established pastures and using it for reseeding in other pastures. English investigators have found it a long-lived, persistent, rapidly spreading, low-growing, sparse-blooming type and have called it English wild white clover. When planted alone in the United States for comparison with commercial white clover from other sources, English wild white has not proved itself as well-adapted as some of the commercial types. Successful seedings with grass, however, have been made in New York State. When the plants of English wild white clover are compared with those of commercial white Dutch, the leaves, stems, and flower heads are found to be much smaller than those of commercial white clover, as shown in figure 2. English wild white does not blossom as freely as common white Dutch. In plantings of white Dutch from commercial seed, a few plants may be found which cannot be distinguished from the English wild white. Examinations of old pastures indicate that they contain low-growing, persistent types, indistinguishable from English wild white, which may be expected to be more adaptable to pasture conditions in the United States. Many State agricultural experiment stations, in cooperation with the Division of Forage Crops and Diseases, Bureau of Plant Industry, United States Department of Agriculture, are endeavoring to determine the relative value of white clover types and how they are affected by different management and fertilizer practices.

Seed Production

White clover is naturally a free-blossoming plant in all parts of the United States, but only in a few sections has seed production developed as a farm enterprise. The difficulty in handling a seed crop, the irregularity of seed production, and the presence of large numbers of troublesome weeds are chiefly responsible for the lack of interest in harvesting white clover seed. Yields of white clover seed range from a few pounds per acre to 450 pounds, but yields of 150 pounds are considered profitable. The yield of seed depends upon the number of flowers in a unit area and the thoroughness of cross-pollination among the heads. Climatic factors have a profound influence upon seed production. Bright, warm weather following early cool, moist weather favors abundant blossoming and cross-pollinations. Even when blossoms are abundant, moist, cloudy weather is unfavorable to bee activity, and necessary cross-pollination is, therefore, restricted and seed production reduced. The presence of colonies of honey bees in the immediate vicinity of clover-seed producing fields usually insures a maximum of cross-pollination. A profitable seed harvest may be secured if the flower heads are numerous and contain from 75 to 150 seeds per head. When sup-

plied with abundant moisture, white clover continues to grow and blossom throughout the summer. Seed is continually setting, and two or more seed crops are often produced.

The seed crop is usually cut with an ordinary mower, as shown in figure 3. Some growers prefer to use a short cutting bar to prevent the skipping of heads that may otherwise result from an uneven soil surface. The clover is generally raked into windrows and allowed to cure thoroughly. Some growers fasten to the cutting bar a metal pan into which the heads are raked by a man who walks behind the mower. When the pan is filled, the clover is raked into bunches and allowed to cure. After 7 to 10 days in the windrow or

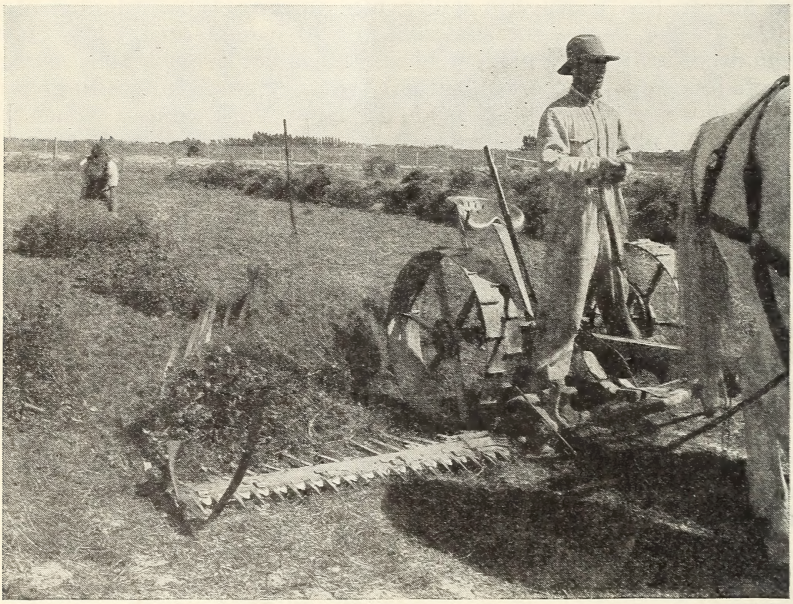

FIGURE 3.—Harvesting white clover seed in Idaho.

bunch the heads may be threshed with a clover huller equipped with screens of small mesh. A considerable amount of seed is unavoidably lost in harvesting operations because the heads break off readily. Damp, moist weather at the time the seed crop is curing is responsible for the browning of seed, which lowers the quality, although germination may not be materially reduced. In the Northwestern States two seed crops are often harvested at one time; the first crop of seed heads is left until the second crop is mature; then both crops are harvested together. Because of the necessity of irrigating the clover for the second growth the water somewhat discolors the first crop of seed. To produce a seed crop of high quality the fields must be free from alsike clover, timothy, and sorrel, as common cleaning equipment cannot separate the seed of these plants from the white clover seed.

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